Island rodents: a new species of *Octodon* from Isla Mocha, Chile (Mammalia: Octodontidae)

By R. Hutterer

Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, Germany

Abstract

A hitherto unknown species of *Octodon* occurs on Isla Mocha, a small coastal island in the Valdivian rainforest zone of central Chile. The new Pacific degu (*Octodon pacificus* n. sp.) exhibits characters such as soft and long fur, long and poorly tufted tail, homodont upper dentition, barely reduced third lower molars, broad and asymmetrical teeth with long reentrant folds full of cement, all of which are considered as plesiomorphic for the genus. It is suggested that geographic isolation led to the preservation of primitive characters. The new species probably represents the sister taxon of *Octodon bridgesii*, one of the three mainland species currently known from Chile and Argentina. The phylogenetic significance of the new degu is discussed.

Introduction

Hystricognath rodents of the family Octodontidae occur in west-central South America, from where six genera *(Aconaemys, Octomys, Octodon, Octodontomys, Spalacopus, Tympanoctomys)* with ten species are known from Bolivia, Chile and Argentina (Pearson 1984; Contreras et al. 1987; Mares and Ojeda 1982; Gallardo and Reise 1992). The systematic status and the contents of the family are rather controversial as no striking synapomorphies are known to characterize the group (Glanz and Anderson 1990); some authors include the Ctenomyidae (Reig 1970, 1986; Reig and Quintana 1991), others the Abrocomidae (Ellerman 1940).

Confusion also exists at the species level. Gallardo and Reise (1992) have recently demonstrated that the genus *Aconaemys* comprises three species, not one or two, as previously thought. Three species are generally accepted in the genus *Octodon: O. degus* (Molina, 1782), *O. bridgesii* (Waterhouse, 1844), and *O. lunatus* Osgood, 1943 (Osgood 1943; Mares and Ojeda 1982; Patterson and Feigl 1987; Reise and Venegas S. 1987; Gallardo 1992; Redford and Eisenberg 1992). Contreras et al. (1987) questioned the validity of *O. lunatus* on morphological grounds but the form has a distinctive karyotype (Spotorno et al. 1988) and certainly is a valid species. However, our knowledge on the taxonomy, distribution and ecology of this genus is far from being complete, as this report will show. New material already collected in 1959 from a small island off central Chile demonstrates the existence of a fourth species of *Octodon*. Its characters considerably enlarge the morphological diversity of the genus. The new degu is named and described below and its significance discussed in the context of the family.

Material and methods

The specimens studied are stored in the collections of the Museum Alexander Koenig, Bonn (ZFMK), the Staatliches Museum für Naturkunde Stuttgart (SMNS), the Senckenberg-Museum Frankfurt (SMF), and the collection of W. von Koenigswald, Paleontological Institute, University of Bonn (VKB). The following specimens were used for illustrations and for comparison: *Octodon degus,* 9

(ZFMK 86.89, 86.701–3, 87.82, 87.361, 88.37; SMNS 1113, 33771), *O. bridgesii,* 9 (ZFMK 88.63, 88.83, 92.309, 92.382; SMNS 534; SMF 11037; VKB 972), *O. lunatus,* 2 (SMNS 42960; SMF 862), *O. sp.,* 4 (ZFMK 92.383–6), *Aconaemys fuscus,* 1 (ZFMK 88.59), *Spalacopus cyaneus,* 1 (ZFMK 92.310). Other sources of information were the descriptions and figures in Thomas (1920), Ellerman (1940), Wood (1949, 1974), Walker et al. (1964), Landry (1970), Reig (1970), Woods and Boraker (1975), Glanz and Anderson (1990), Nowak (1991), Reig and Quintana (1991), and de Santis et al. (1991). The terminology of the skull and the teeth follows Wood and Wilson (1936) and Woods and Howland (1979). All measurements are in millimetres. A note is required about the use of the name *Aconaemys* in this report. According to Reig (1986) the genus *Pithanotomys,* based on a fossil, has priority over *Aconaemys.* However, evidence which the author announced to be presented in a forthcoming paper was never published except for the same statement plus one figure of upper and lower dentition in Reig and Quintana (1991). Although the similarity between the molars of the extant *Aconaemys fuscus* and the Pliocene *Pithanotomys columnaris* is striking, the shape and structure of the skull has not been described. I therefore refrain from following Reig and Quintana (1991) until a thorough comparison of both extant and fossil forms has been published.

Results and discussion

Octodon pacificus, new species

Holotype: ZFMK 92.384, skin and skull of an adult female, collected by Francisco Behn on 16 January 1959, field number L 6. The skin is in good condition, the cranium (Fig. 2) lacks the occipital and the bullae; the mandible is complete.

Paratypes: Skins and skulls of another adult female (ZFMK 92.383; Fig. 1) and of two juveniles (ZFMK 92.385–6), collected between 11 and 24 January 1959 by F. Behn.

Measurements: See tables 1 to 3.

Type locality: Isla Mocha (38°22′ S, 73°55′ W), Arauca Province, Chile. Mocha Island is situated 31 km off the coast; its maximum extension from north to south is 13 km, and 5–7 km from west to east. The centre of the island forms a plateau of about 20 square kilometres which is almost entirely covered by myrtle forest (Mrs. Erika Behn, in litt.). Two peaks ascend to an altitude of 323 m in the north and 390 m in the south of the island. A lake is on top of the hills. Valleys run down from these peaks to the eastern coast. Large meadows cover the coastal plains of the island. Dr. Behn did not specify where he collected the small mammals but a recent map shows two airstrips on the eastern side of the island and one of them may have been the meadow where his expedition landed and camped. Bullock (1935) described the island as a hilly plateau covered with virgin forest, almost inacessable except where the inhabitants cut tracks into the forest. A short description of the island and its vegetation is also provided by Almeyda Arroyo (1955). Translated from Spanish it reads: "To the eye of the seaman Mocha Island presents a beautiful green aspect: the hills up to the peaks and the slopes towards the sea are covered with large trees, providing easy access to wood." Isla Mocha is near the northern limit of the Valdivian rainforest zone, as outlined by Osgood (1943). Rocks and sediments of the island are of Miocene, Pliocene and Quaternary ages (Tavera and Veyl 1958).

Diagnosis: Larger and heavier than the three other species of *Octodon;* fur uniformly dark brown washed with orange, hairs soft and long; tail long (77 % of head and body length) with inconspicuous tuft. Skull long, particularly the diastema; zygomatic arches wide in dorsal and straight in lateral view; zygomatic process of squamosal inserting very high; superior jugal process forming a characteristic spine. Upper cheek-teeth very broad and uniform, the long reentrant folds filled with cement; lower cheek-teeth more or less homodont, their folds running strongly oblique and almost parallel; reentrant folds also cemented; the third lower molar is large and has the shape of an Arabic numeral 1.

Description: Although *Octodon pacificus* n. sp. is larger and heavier than *O. bridgesii, O. lunatus* and *O. degus* (Tab. 1), its body appears to be more slender (Fig. 1). The overall

colour of the pelage is brown-orange, with the orange tips being brighter on the hairs of the underside. The dorsal hairs are 22 mm long on average and very soft, scattered long guard hairs being up to 27 mm. The basal 80 % of the dorsal hairs are plumbous, their tips are brown-orange. The head of the animal is uniformly coloured; no pale eye rings are present. The relatively short dark ears appear almost naked, bearing only very fine short hairs. No white or yellow ear tufts exist. The snout bears about 30 vibrissae, some of which are black and others white. The forefeet have 4 digits with claws and a tiny pollex with a very reduced nail. Their dorsal surfaces are covered with greyish-brown hairs; they turn to white at the outer edge of each forefoot. The ventral surfaces are naked and show a granulation which is typical for the genus. Each palmar surface has three interdigital and two palmar pads. The hairs on the dorsal surfaces of the hindfeet are creamy-brown. A group of long and stiff white hairs sit on top of each digit. Finely granulated skin covers the space between the five interdigital and two plantar pads on the ventral surfaces of the hindfeet. The tail is long (77 % of head and body length), thinly haired, with the terminal 50 mm bearing a tuft of slightly longer and darker hairs. The more proximal part of the tail is brown on the dorsal and cream-brown on the ventral surface; the inconspicuous terminal tuft appears dark brown.
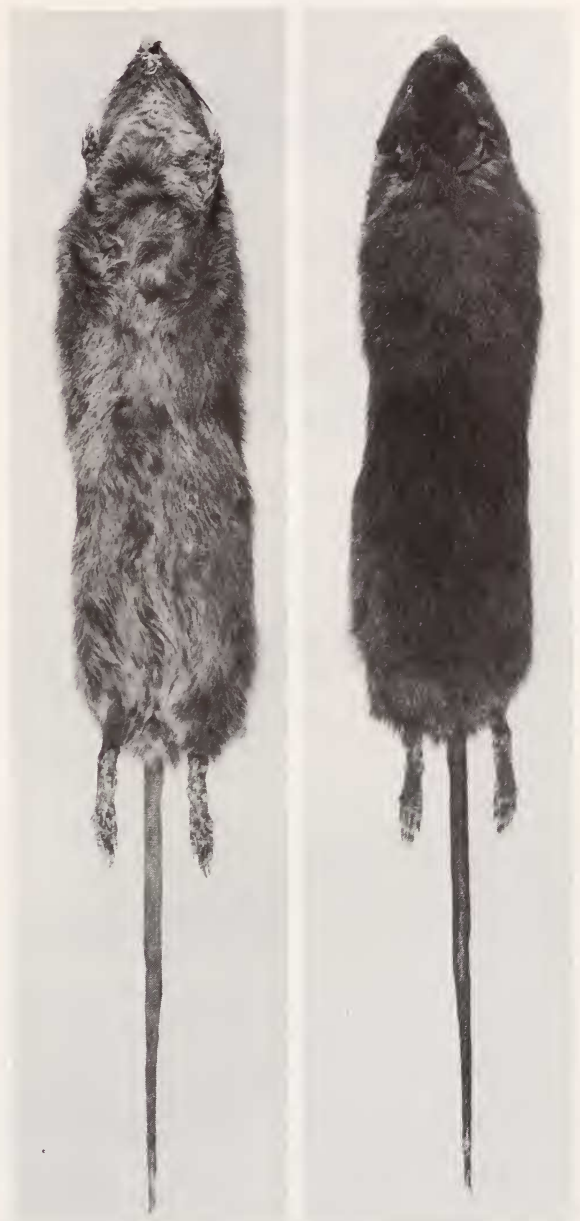

Fig. 1. Octodon pacificus n. sp., dorsal and ventral aspect of the skin of paratype ZFMK 92.383; total length of the specimen is 390 mm

The cranium of *Octodon pacificus* n. sp. is shown in Fig. 2. Unfortunately, the bullae and the occipital have not been preserved, due to the initial preparation of the animals in the style of a bird skin. The skulls were subsequently removed from inside the skins and
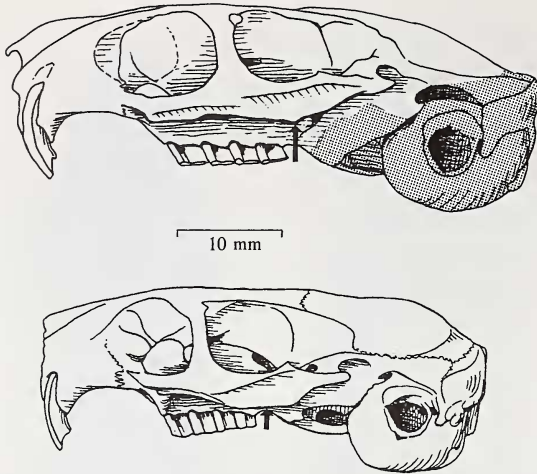
10 mm

Fig. 2. Lateral view of a cranium of *Octodon pacificus* n. sp. (based on the holotype, missing parts of the shaded area reconstructed), and of a cranium of *O. degus* (below, adopted from Woods and Boraker 1975). Note the differences in size, diastema, infraorbital foramen, and the position of the inferior rim of the zygomatic arch (arrowed)
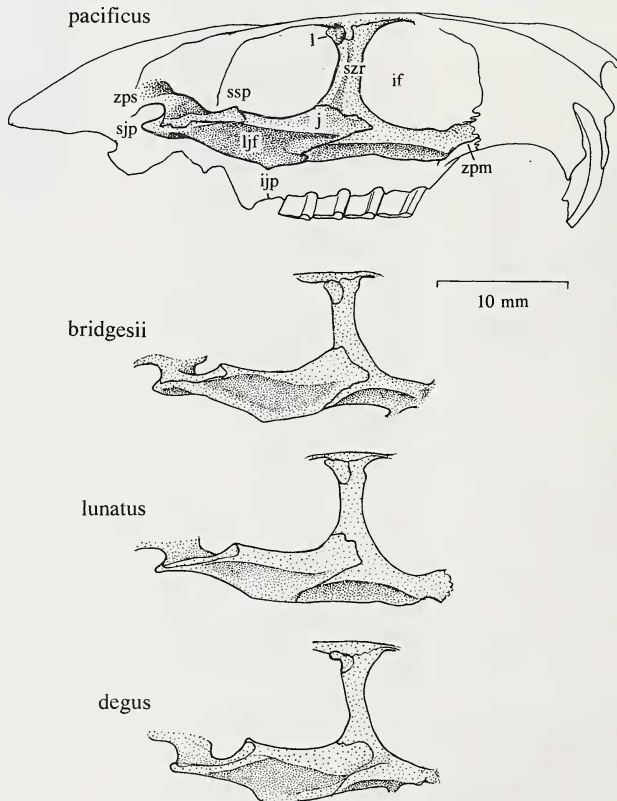

pacificus

bridgesii

10 mm

lunatus

degus

Fig. 3. A comparison of the zygomatic arch in the four species of *Octodon*. *if:* infraorbital foramen; ijp: inferior jugal process; j: jugal; l: lacrymal; ljf: lateral jugal fossa; sjp: superior jugal process; ssp: superior squamosal process; szr: superior zygomatic root; zpm: zygomatic process of maxillary; zps: zygomatic process of squamosal

the skins reworked as standard study skins in 1992. The skull is large and broad, with a long diastema, a large infraorbital foramen, and a broad interorbital constriction. The lateral ridges of the frontals form a thin, translucent roof which extends further than in the other species. The measurements for the zygomatic width of both adult specimens exceed all known measurements for the other species (Tab. 2); the same holds for the length of the nasals. The tips of the nasals pro-
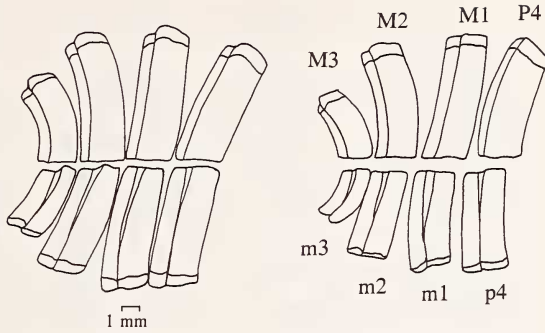

Fig. 4. Isolated left upper and lower molars of *Octodon pacificus* n. sp. (left side) and *O. bridgesii* in lingual view

ject further than in the other species of the genus (Fig. 2). In its general configuration the skull of *Octodon pacificus* n. sp. resembles more that of *O. bridgesii*. In side view the zygomatic arch is diagnostic: its jugal-maxillary part is very straight, as is the upper rim of the lateral jugal fossa; the insertion of the zygomatic process of the squamosal is very high, leaving considerable space between the inferior jugal process and the upper molar row (Figs. 2, 3). The superior jugal process forms a characteristic spine, less developed in the other species of the genus. The superior zygomatic root points slightly obliquely in anterior direction, whereas this bone is upright or even points posteriorly in the other species (Fig. 3). The superior squamosal process is poorly developed, much less so than in *O. lunatus* and *O. degus*.

The upper incisors are thick and broad (Tab. 2) and their position is opisthodont; the anterior surfaces are stained orange, and the tips are deeply notched. The upper cheek-teeth are rootless (Fig. 4) and larger and especially broader than in the other species (Tab. 3, Figs. 5, 6). Both upper and lower teeth are more uniform in size and shape than in the other species (Fig. 4). In fact, the upper P4 to M3 show only minor differences in size, not in shape. All are highly asymmetrical with a heavy paracone and metacone and a long reentrant fold which is almost completely filled with cement (Fig. 6). The same is true for the lower cheek-teeth; here the two enamel folds run parallel to each other and strongly oblique. The third lower molar is somewhat simplified but keeps the size and aspect of the

Table 1. **External measurements and body mass of samples of *Octodon*; size data for species other than *pacificus* n. sp. taken from Redford and Eisenberg (1992), and body mass from Bozinovic (1992)**

	O. pacificus n. sp.		*O. bridgesii* n3–4	*O. lunatus* n4–6	*O. degus* n64–75
	holotype	paratype			
Total length	380	390	323.0 250–370	360.0 328–382	266.5 200–307
Tail length	170	165	138.3 102–167	157.0 152–161	111.4 81–138
Hindfoot c.u.	40	42	38.5 34–40	40.7 40–42	35.5 31–40
Ear	20	20	22.0 20–23	28.0 –	24.7 19–31
Body mass (g)	290	290	176.1 (n23)	173.2 (n24)	195.0 (n52)

Table 2. Cranial measurements of some specimens of *Octodon* spp.

	O. pacificus n. sp.[1]		*O. bridgesii*[2]	*O. lunatus*[3]	*O. degus*[4]
Greatest length	[46.3]	–	41.8–44.8	46.5	43.3
Zygomatic width	25.9	25.3	23.7–23.9	23.8	23.9
Interorbital width	10.0	8.6	8.1– 9.0	9.1	10.3
Nasalia length	19.6	19.5	17.6	18.0	15.6
Nasalia width	5.9	5.6	5.1– 5.8	5.8	5.3
Diastema length	10.8	10.6	8.1– 9.9	8.7	8.8
Upper toothrow, crowns	10.3	10.9	9.5–10.0	9.3	9.5
Upper toothrow, alv.	11.1	11.3	9.6–10.6	10.7	10.1
Width P4–P4	7.8	8.2	6.5– 7.7	8.6	6.2
Width of both upper I1	4.0	4.2	3.1– 3.7	4.2	3.6

[1] holo-, paratype. – [2] 6 skulls (ZFMK, SMNS, VKB). – [3] SMNS 42960. – [4] ZFMK 86.701.

Table 3. Width of upper (P4–M3) and lower (p4–m3) cheek-teeth of two adult specimens each of *Octodon pacificus* n. sp. (holo- and paratype), *O. bridgesii*, and *O. degus*

	O. pacificus n. sp.	*O. bridgesii*	*O.degus*
P4	2.82, 2.85	2.57, 2.50	2.04, 2.11
M1	2.57, 2.70	2.40, 2.29	1.96, 1.98
M2	2.67, 2.62	2.39, 2.31	1.99, 1.96
M3	2.34, 2.28	1.99, 1.84	1.79, 1.66
p1	2.26, 2.22	2.22, 2.30	1.85, 1.89
m1	2.27, 2.47	2.41, 2.24	1.93, 2.15
m2	2.30, 2.45	2.15, 2.16	1.76, 1.62
m3	2.05, 2.33	1.66, 1.74	1.50, 1.56

other molariform teeth. In occlusal view, this tooth resembles the Arabic numeral 1 (Fig. 6).

The mandible is larger and heavier than in the other species of the genus, as are the lower incisors. The condyloid process is particularly broad and heavy, corresponding to a large glenoid fossa of the squamosal, as may be inferred from the development of the posterior zygomatic root of the cranium (Fig. 3).

Fig. 5. Occlusal view of upper and lower molars. *Left: Octodon bridgesii* (ZFMK 88.63), *middle:* O. *pacificus* n. sp. (ZFMK 92.384), *right:* O. *pacificus* n. sp. (ZFMK 92.383); for measurements, see table 2
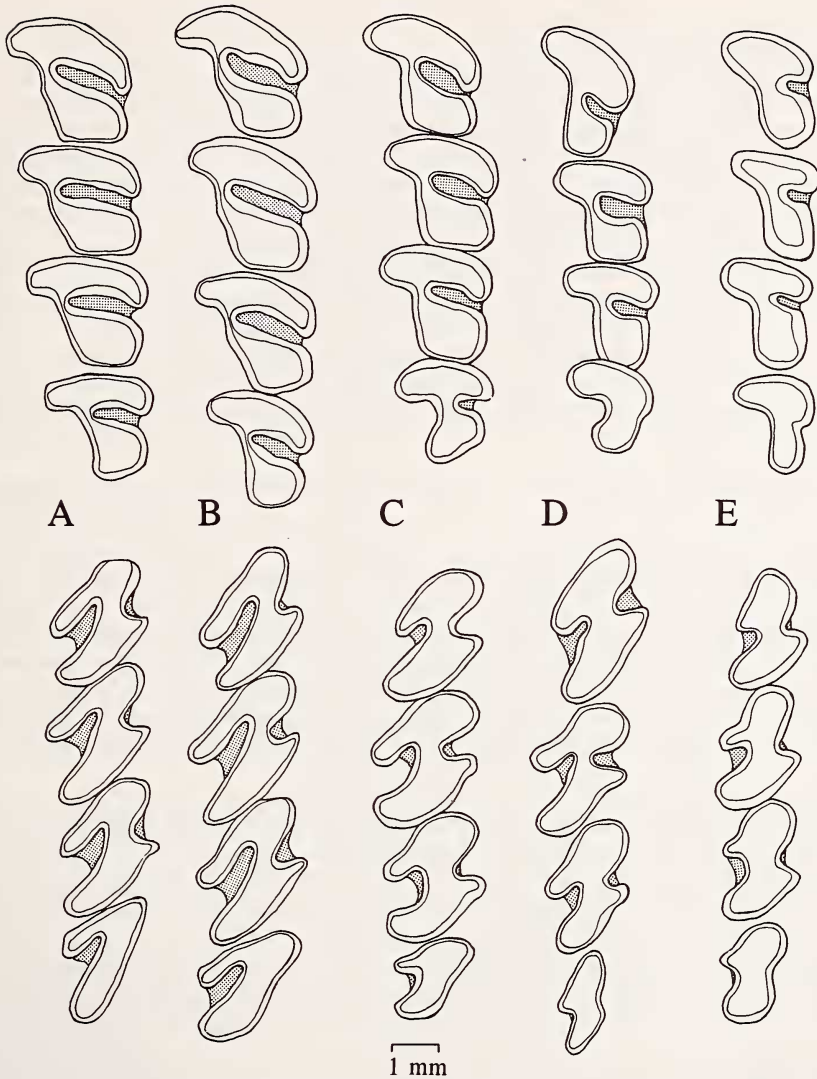
Fig. 6. Occlusal view of right upper and right lower molars of the four species of *Octodon*. A: *O. pacificus* n. sp. (holotype), B: *O. pacificus* n. sp. (paratype), C: *O. bridgesii* (ZFMK 88.63), D: *O. lunatus* (SMNS 42960), E: *O. degus* (ZFMK 86.701). The shading indicates cement

Notes on juveniles: As mentioned above, two juveniles were collected together with the two adult females. Their general appearance matches that of the adults, except the fur is duller. Especially the venter is more grey and not washed with orange. The weights of the young were 50 and 55 g, respectively, and the upper and lower third molar were not erupted. Their age may be estimated at two or three weeks. Assuming this age, they would have been born around the last week of December. Taking a gestation time of 90 days as in *Octodon degus* (WEIR 1974), conception would have occurred in September of the previous year. This coincides with the reproduction period of *Octodon degus* near Santiago, Chile (FULK 1976).

Comparisons: The three species of *Octodon* currently recognized can be distinguished from *O. pacificus* n. sp. as follows:

Octodon degus, type species of the genus, is smaller and has a stouter body; it has a shorter tail with a thick terminal brush, a coarse, agouti-coloured fur, a lighter venter and white ear tufts. In five specimens examined the pollex bears a small but clearly pointed claw, which contrasts to the reduced nail of the new species. The statement of OSGOOD (1943) that the species of the genus *Octodon* bear a nail on the pollex is not always correct. BENNETT (1832), when diagnosing the genus *Octodon* and his new species *cumingii* (a synonym of *degus*), correctly stated that "the thumb of the fore feet has a short obtuse claw", not a nail. Nevertheless, OSGOOD's statement is equally found in standard references such as WOODS and BORAKER (1975). It may be possible that the character is variable but this has to be checked in a larger series. The observed differences between *O. degus* (claw) and *O. pacificus* n. sp. (nail), however, are very clear and rather suggest the existence of a good diagnostic character. The skull of *O. degus* is smaller and the position of the zygomatic arch is lower (Fig. 2). This species has the simplest molars of the genus (Fig. 6): upper and lower molariform teeth are fairly symmetrical and approach an 8-shape more than any other *Octodon*.

Octodon lunatus is similar to *O. degus* externally and cranially, although OSGOOD (1943) claimed that his new species was indistinguishable from *O. bridgesii*. The specimen at hand matches perfectly the description of OSGOOD, particularly with respect to the lunariform third upper molar (Fig. 6). Externally, the specimen differs from *degus* by a somewhat softer and longer pelage although the agouti colour is very similar. The underside of the skin, however, is paler and washed with cream-white. Yellow ear tufts are present. The dorsal surfaces of hands and feet are white. The pollex of the manus bears a nail, not a claw. The tail is long with a prominent terminal brush, dorsally dark brown, ventrally white on the first half and blackish-brown on the terminal part. Long whitish guard hairs are present mainly on the posterior part of the fur. The skull is similar to *O. degus* and *O. bridgesii*, but the M3 is diagnostic (Fig. 6).

Octodon bridgesii is similar to *O. pacificus* n. sp. in the softer texture of the fur, and in its trend towards asymmetry of the teeth (Figs. 5, 6). In addition, the pelage is more uniform and lacks white or yellow ear tufts. The colour of the body hairs is a mixture of brown and yellow, not orange. The tail is shorter (75 % of head and body length) but is similar to *pacificus* n. sp. in not having such a prominent terminal tuft (WATERHOUSE 1844; MANN 1958) as in *O. degus* and *O. lunatus*. Averages for *Octodon bridgesii* are smaller for all measurements (Tab. 2). Clear-cut differences to *O. pacificus* n. sp. exist in the size and shape of the skull, the shape and position of the zygomatic arch (Fig. 3), and in the size and form of the molariform teeth (Fig. 6), particularly in the upper and lower third molars.

History of discovery: The discovery of this new rodent has been a matter of enthusiastic research effort and personal tragedy. One person involved is Dr. FRANCISCO BEHN (11. 6. 1910–28. 5. 1976), formerly a Professor of Anatomy and Pathology at the University of Concepción, Chile, and a free-time ornithologist. Although occupied by his profession he also spent his free time with the study of birds and such contributed to the ornithology of Chile (BEHN and MILLIE 1957). Together with his wife ERIKA BEHN he brought together an important collection of birds from northern Chile to Antarctica. For many years he corresponded with Dr. GÜNTHER NIETHAMMER (28. 9. 1908–14. 1. 1974), at that time curator of birds at the Museum Alexander Koenig, Bonn, whom he knew personally from a visit to Bonn in 1954, as evidenced by documents in the archives of the Bonn Museum. In 1959 Dr. BEHN and his family made an expedition to Isla Mocha where they camped for two weeks. On the first of September, 1959, he wrote to G. NIETHAMMER [translated from German]: "All of January I visited an ornithologically extremely interesting island, which is situated some kilometres south of Concepción off the mainland: the so-called Isla

Mocha. It has been studied only once before in more detail by a bird watcher, since access is only possible by aircraft which has to land on the beach or on one of the meadows."

In his letter BEHN enthusiastically continued to talk about his observations on the nesting habits of a seabird, *Puffinus creatopus,* which he planned to write up and publish as soon as his busy professional life would allow. For unknown reasons he never did so and all his experience was lost with his death in 1976. It remained also unknown that on his expedition to Isla Mocha he had collected a small number of mammals which he sent to G. NIETHAMMER's then 22 year-old son, JOCHEN NIETHAMMER, who later became Professor of Zoology at Bonn University. The specimens remained unstudied for more than thirty years in his private collection and came to light only recently when it was transferred to and curated at the Museum Alexander Koenig, a final consequence of his tragic car accident which happened on an excursion with students in July 1991. Severe injuries terminated the career of this well-known mammalogist, main editor of the "Handbook of European Mammals" and author of numerous papers on Palaearctic and African mammals, but also the discoverer of the extinct giant rat of the Galapagos Islands (NIETHAMMER 1964).

Etymology: The species is currently known only from a small island in the Pacific Ocean, hence its specific epithet.

Other mammals: Very little is known on the remaining mammal fauna of Isla Mocha. PHILIPPI (1900) described a new mouse as *Mus mochae,* which OSGOOD (1943) assigned to *Akodon olivaceus* (Waterhouse, 1837). OSGOOD (1943) also reported on three other rodent species obtained by D. S. BULLOCK in 1932 on this island. Apart from the new *Octodon* and samples of *Akodon longipilis castaneus* Osgood, 1943 (ZFMK 92.387–389), and *Akodon olivaceus mochae* (Philippi, 1900) (ZFMK 92.390–393), the small collection obtained by F. BEHN in 1959 contains a specimen of *Rattus rattus* Linnaeus, 1758 (ZFMK 92.394), a species which has not been reported from this island before. Table 4 summarises

Table 4. **Mammals recorded from Isla Mocha, based on** PHILIPPI (1990), OSGOOD (1943), **and the present report**

	Collectors		
	PHILIPPI (1900)	BULLOCK (1932)	BEHN (1959)
Octodon pacificus n. sp.			x
Akodon longipilis		x	x
Akodon olivaceus	x	x	x
Geoxus valdivianus		x	
Oryzomys longicaudatus		x	
Rattus rattus			x

the small mammal species so far known from Isla Mocha. The cricetine rodents listed are characteristic for the temperate Valdivian rain forest on the neighbouring mainland (MESERVE et al. 1982). However, the material from Isla Mocha stored at the American Museum, the British Museum, and the Bonn Museum deserves careful study of its own. Some subspecies named for populations of Isla Mocha may in fact represent full species. This seems probable for *Akodon longipilis castaneus,* the skull of which differs markedly from what REIG (1987) figured as representing the typical mainland population of *A. longipilis.*

Relationships within the genus *Octodon*

Looking at morphological characters, the four extant species of *Octodon* fall into two groups. One includes *O. bridgesii* and the new species, the other *O. degus* and *O. lunatus*. The first two species share the following characters: uniform colouration, soft pelage, short ears, long but inconspicuously tufted tail, asymmetrical teeth with a long reentrant fold. Photographs of live *O. bridgesii* and *O. degus* in REISE and VENEGAS S. (1987) neatly illustrate the external differences. *O. degus* and *O. lunatus* share the more vivid colouration, hairs of agouti-type, light eye marks, larger and tufted ears, pronounced black tail tufts, less asymmetrical teeth, and highly reduced third molars. The author regards most of the characters of the first group as primitive and those of the second group as derived for the genus.

The supposed polarities are based on an outgroup comparison with fossil Octodontidae (WOOD 1949; PASCUAL 1967; PATTERSON and WOOD 1982; REIG and QUINTANA 1991), Ctenomyidae (PASCUAL et al. 1965; REIG 1970; VERZI et al. 1991) and Echimyidae (PATTERSON and PASCUAL 1968; LAVOCAT 1976), particularly with the Oligocene *Platypittamys brachyodon* Wood, 1949, which is often taken as an ancestor model for the living Octodontidae. This assumption is justified because fossils of *Platypittamys* share a characteristic enamel structure with the extant Octodontoidea (MARTIN 1992), but not with other Caviomorpha. It should, however, be noted that REIG and QUINTANA (1991) presented a different view of molar evolution in octodontids which will be discussed below.

An ingroup comparison reveals that *Octodon pacificus* n. sp. assembles more plesiomorphic characters than the other three species. The high position of the zygomatic process of the squamosal is only found in *O. pacificus* n. sp. (Fig. 2); it is shared with *Platypittamys* (WOOD 1949). *Platypittamys* and some other fossil octodontids have strongly asymmetrical and homodont molars (WOOD 1949). Within genus *Octodon, O. pacificus* n. sp. approaches these conditions more than the other species (Figs. 6, 8). A reduction of the third molars, as in *O. degus* and *O. lunatus*, is certainly a derived feature and may be a general evolutionary trend in octodontoid rodents.

In conclusion, *Octodon pacificus* n. sp. may be regarded as the most primitive species of the genus. Geographically isolated and in the absence of similar-sized competitors the species may have lived on Isla Mocha since the Miocene, the geological age of the island (TAVERA and VEYL 1958). Some morphological changes, however, must have occurred, as the large infraorbital foramen and the backward position of the superior zygomatic root (Fig. 3) are derived characters. *O. pacificus* n. sp. and *O. bridgesii* most probably had a common ancestor; both share a similar morphology and possibly similar ecological requirements. They have the southernmost distributions of the genus (Fig. 7) and seem to be more restricted to forest (GREER 1968; MESERVE et al. 1982) than *O. degus* and *O. lunatus* which are adapted to life in semiarid shrublands (WOODS and BORAKER 1975; CONTRERAS et al. 1987; MESERVE and LE BOULENGÉ 1987; BOZINOVIC 1992).

How does this interpretation fit with the available chromosomal data? *O. degus* and *O. bridgesii* have 58 chromosomes (GALLARDO 1992), while *Octodon lunatus* has 78 (SPOTORNO et al. 1988) (Tab. 5). GALLARDO (1992) discussed in detail the polarities of the karyotypes concluding that 58 represents the plesiomorphic condition and the higher number of 78 a derived condition. This view, which is in contradiction to SPOTORNO et al. (1988), is in full congruence with the morphological conclusions made above.

Comparisons with other Octodontidae

It is a matter of curiousity that the type genus of the family, *Octodon*, does not show the character for which it was named (Fig. 8). 8-shaped teeth are found in *Aconaemys* (MANN
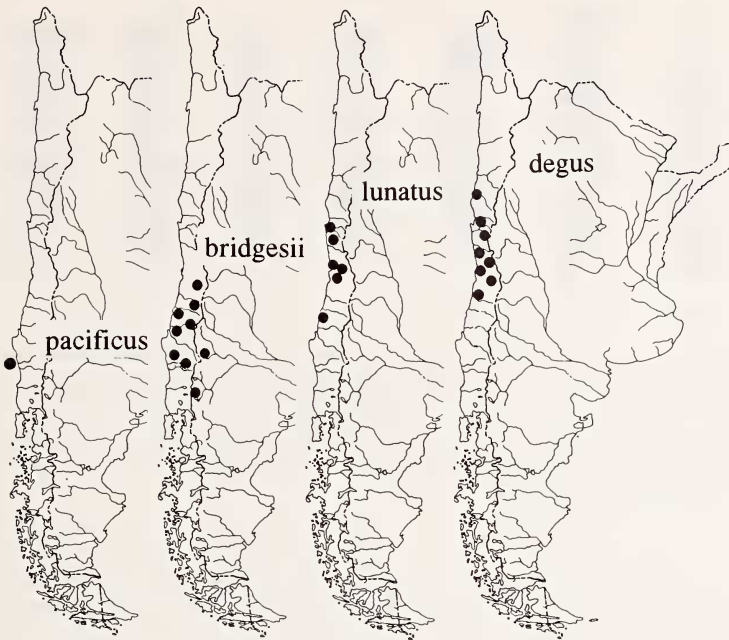
Fig. 7. Maps of Chile and Argentina with the approximate distributions of the four species of *Octodon* indicated; in part adopted from REDFORD and EISENBERG (1992), modified

1958; GLANZ and QUINTANA 1991), and *Spalacopus* (REIG 1970), while *Octodon* (Figs. 6, 8) and *Octodontomys* (GLANZ and ANDERSON 1990) have asymmetrical teeth; the latter genus has no reentrant folds at all. If we look again at *Platypittamys* (Fig. 8), we would have to take *Octodon* as the most primitive genus of Octodontidae, with *Octodontomys* perhaps as an offshoot of *Octodon,* and *Aconaemys, Octomys, Tympanoctomys,* and *Spalacopus* as members of a more derived clade. This grouping coincides largely with THOMAS (1920), who divided the then known genera in a group with "crescentic" and another with "8-shaped teeth". REIG and QUINTANA (1991) argued for the contrary. They did not mention *Platypittamys* but stated that 8-shaped molars, as in *Aconaemys,* are primitive and asymmetrical ones, as in *Octodon,* are derived, a view obviously taken from the Miocene *Pseudoplataeomys elongatus* which has perfectly 8-shaped molars (REIG and QUINTANA 1991). They also described a new genus, *Abalosia,* from the Pleistocene of Argentina, which in their interpretation may have been the ancestor of genus *Octodon.* While the present author can concur that *Pseudoplataeomys* may have been ancestral to the group of octodontids with 8-shaped molars *(Aconaemys, Octomys, Tympanoctomys, Spalacopus),* it does not follow that *Octodon* is derived from the Pleistocene *Abalosia.* This genus has very simple molars resembling *Octodontomys* (Fig. 8) but it also has very long upper third molars which are quite unusual for the group. Also the skull of *Abalosia,* as figured by REIG and QUINTANA (1991), is not similar to *Octodon* but instead recalls the skull of *Aconaemys* with its short nasals, broad interorbital region, parallel molar rows, and stout mandible. The phylogenetic position of ABALOSIA should thus be regarded as uncertain and its postulated relation to *Octodon* cannot be accepted. If we include the Oligocene *Platypittamys* in this comparison then again *Octodon* would group next to it (Fig. 8). The Pliocene *Chasicomys octodontiforme* Pascual, 1967 shows a somewhat intermediate morphology of the upper molars (PASCUAL 1967) and may be taken as support for the supposed direction of molar evolution. It can be supposed that different groups of
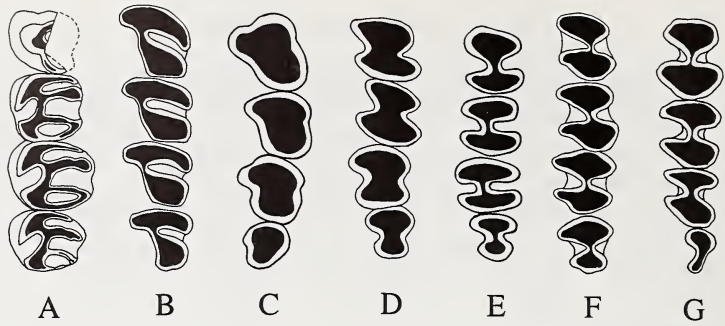
Fig. 8. Right upper molars of octodontid rodents. A: *Platypittamys brachyodon* (copied from Wood 1949, slightly simplified); B: *Octodon pacificus* n.sp. (paratype); C: *Octodontomys gliroides* (copied from Reig and Quintana 1991, reversed); D: *Spalacopus cyaneus* (ZFMK 92.310); E: *Tympanoctomys barrerae* (copied from Reig and Quintana 1991, reversed); F: *Aconaemys fuscus* (ZFMK 88.59); G: *Octomys mimax* (copied from Ellerman 1940, modified). Not to scale, tooth rows brought to approximately the same length for the purpose of comparison

octodontids already diverged in the Miocene, and that their phylogeny is at present obscured by an incomplete fossil record. Verzi et al. (1991) also concluded from their work on fossil Octodontoidea that octodontine and ctenomyine rodents radiated contemporaneously in the Miocene.

If we neglect the molars and look only at the skull, then *Tympanoctomys* (Landry 1957; de Santis 1991) would be the candidate for the most primitive genus because of its small infraorbital foramen and the extremely anterior position of the superior zygomatic root, which is shared by *Platypittamys* but not by any of the other five genera. On the other hand, *Tympanoctomys* and *Octomys* (Thomas 1920; Walker et al. 1964) both have hypertrophied auditory bullae, certainly derived structures related to their gerbil-like habitus.

The chromosome complements, which surprisingly are known for all species except *Octodon pacificus* n.sp., present a slightly different picture (Tab. 5). *Aconaemys, Octomys, Spalacopus,* and *Octodon* have very similar karyotypes, whilst *Octodontomys* has a lower (38) and *Tympanoctomys* a much higher (102) chromosome number. The latter two genera may be taken as derived in this character.

Table 5. Chromosome numbers of the species of Octodontidae; adopted from Gallardo (1992), Gallardo and Reise (1992), and references cited therein

Species	2N	FN
Aconaemys fuscus	56	108
Aconaemys porteri	58	112
Aconaemys sagei	54	104
Octomys mimax	56	108
Spalacopus cyaneus	58	112
Octodon degus	58	112
Octodon bridgesii	58	112
Octodon lunatus	78	114
Octodontomys gliroides	38	64
Tympanoctomys barrerae	102	198

None of the different data sets provides a convincing solution of the phylogenetic relations between the six extant genera of Octodontidae, nor does the work based on blood protein similarities of only three genera (Woods 1982). At present it seems impossible to solve the phylogenetic relationships within the Octodontidae with the given information. One reason may be that the six extant genera represent only a small portion of the past diversity, a view held also by Gallardo (1992) and suggested by the fossils which are already known (Mones 1986; Reig and Quintana 1991) although many more fossils may be expected. Nevertheless, study of the fossil record together with the extant species allows the formulation of hypotheses on

evolutionary trends which could be tested in the future against more complete data sets based on other character complexes.

A note on island rodents and conservation

Since Osgood's comprehensive work (1943), the mammal fauna of Chile is regarded as one of the best-studied in South America (Patterson and Feigl 1987). The latter authors predicted that "further additions to the faunal list are apt to be those species with highly restricted geographic ranges, especially those in remote areas". This is perfectly true in the case of Isla Mocha, and counts also for two other rodents discovered on islands in southern Chile: *Akodon markhami* (Pine 1973) and *Akodon hershkovitzi* (Patterson et al. 1984). While those rodents were collected rather recently, the collection of the Pacific degu dates already from 1959. No attempts have been made since to check the actual status of the new species. It is not known whether it still forages in the meadows or forest of Mocha Island, nor, in the positive case, how large the population may be. What seems certain is that the natural range of the species covers only a few square kilometres and for this reason alone it must be regarded as vulnerable. Soft fur, orange-brown colour and the long tail suggest that this degu lives in the forest, thickets or swamps, which are restricted habitats on the island. In a report on the endangered mammals of Chile Miller et al. (1983) classified one of the mainland species, *Octodon bridgesii*, as vulnerable. They stated that the range of the species had been much reduced, presumably by increased cultivation of its valley habitat. If this is true for a rather widespread species, then such threats may apply even more to a small island population. The sample of Francisco Behn also shows (Tab. 4) that black rats were already present on Isla Mocha in 1959. Numerous examples show how fast endemic mammal faunas on islands are destroyed by human occupation, just to mention the Galapagos (Steadman and Ray 1982), the West Indies (Morgan and Woods 1986), or the Canary Islands (Boye et al. 1992). In the case of Mocha Island, a considerate field survey is suggested to test whether the Pacific degu still exists. Chilean mammalogists should feel encouraged to study this aspect · and propose conservation measures, if necessary.

Acknowledgements

Zusammenfassung

Nagetiere auf Inseln: eine neue Octodon-Art von der Isla Mocha, Chile (Mammalia: Octodontidae)

Auf der 31 km vor der chilenischen Küste gelegenen Insel Mocha lebt ein bisher unbekannter Degu, der unter dem Namen *Octodon pacificus* n. sp. beschrieben wird. Es handelt sich um eine große, weichhaarige und langschwänzige Art von einheitlich braun-orangener Färbung, der helle Überaugenstreifen oder Ohrbüschel fehlen. Weiterhin bemerkenswert sind die homodonte Backenbezahnung und die asymmetrische Form der molariformen Zähne, deren linguale Schmelzfalten vollständig mit Zement ausgefüllt sind. Im Vergleich zu fossilen Octodontidae erweisen sich die meisten Merkmale der neuen Art als plesiomorph; nächstverwandt dürfte *Octodon bridgesii* sein, während *O. degus* und *O. lunatus* einer anderen abgeleiteten Gruppe zugerechnet werden. Beziehungen der 6 rezenten Gattungen der Familie untereinander und zu fossilen Vertretern werden diskutiert. Der neue Pazifik-Degu ist offenbar eine Reliktart, die auf der kleinen Insel Mocha überlebt hat. Das vorhandene Belegmaterial wurde bereits 1959 von dem chilenischen Arzt Francisco Behn gesammelt. Der gegenwärtige Status der Art ist nicht bekannt.

References

ALMEYDA ARROYO, E. (1955): Geografia de Chile. 16. ed. Santiago de Chile: Impr. Talleres.

BEHN, F.; MILLIE, G. R. (1957): Notes. In: Suplemento de Las Aves de Chile. Ed. by J. D. GOODALL, A. W. JOHNSON, and R. A. PHILIPPI B. Buenos Aires, Argentina.

BENNETT, E. T. (1832): Characters of a new genus of Rodent Mammalia, presented by Mr. Cuming. Proc. zool. Soc. London, 46–48.

BOYE, P.; HUTTERER, R.; LÓPEZ-MARTÍNEZ, N.; MICHAUX, J. (1992): A reconstruction of the Lava mouse *(Malpaisomys insularis)*, an extinct rodent of the Canary Islands. Z. Säugetierkunde **57**, 29–38.

BOZINOVIC, F. (1992): Rate of basal metabolism of grazing rodents from different habitats. J. Mammalogy **73**, 379–384.

BULLOCK, D. S. (1935): Las aves de la isla de la Mocha. Rev. Chil. Hist. Nat. **39**, 232–253.

CONTRERAS, L. C.; TORRES-MURA, J. C.; YÁÑEZ, J.-L. (1987): Biogeography of octodontid rodents: an eco-evolutionary hypothesis. Fieldiana Zoology, N. S. **39**, 401–411.

ELLERMAN, J. R. (1940): The families and genera of living rodents. Vol. I. Rodents other than Muridae. London: The Trustees of the British Museum.

FULK, G. W. (1976): Notes on the activity, reproduction and social behavior of *Octodon degus*. J. Mammalogy **57**, 495–505.

GALLARDO, M. H. (1992): Karyotypic evolution in octodontid rodents based on C-band analysis. J. Mammalogy **73**, 89–98.

GALLARDO, M. H.; REISE, D. (1992): Systematics of *Aconaemys* (Rodentia, Octodontidae). J. Mammalogy **73**, 779–788.

GLANZ, W. E.; ANDERSON, S. (1990): Notes on Bolivian mammals. 7. A new species of *Abrocoma* (Rodentia) and relationships of the Abrocomidae. Amer. Mus. Novit. **2991**, 1–32.

GREER, J. K. (1968): Mamíferos de la Provincia de Malleco. Publ. Mus. "Dillman S. Bullock", Angol **12**, 1–114.

LANDRY, S. O. (1957): The relationship of *Petromys* to the Octodontidae. J. Mammalogy **38**, 351–361.

LAVOCAT, R. (1976): Rongeurs caviomorphes de l'Oligocène de Bolivie II. Rongeurs du Bassin Déséadien de Salla-Luribay (Collection Hoffstetter). Palaeovertebrata **7**, 15–90.

MANN, F. G. (1958): Clave de determinación para las especies de Mamíferos Silvestres de Chile. Trab. Centro Invest. Zool. Univ. Chile **3**, 1–38.

MARES, M. A.; OJEDA, R. A. (1982): Patterns of diversity and adaptation in South American histricognath rodents. Special Publ. Ser. Pymatuning Lab. Ecol., Univ. Pittsburgh **6**, 393–432.

MARTIN, T. (1992): Schmelzmikrostruktur in den Inzisiven alt- und neuweltlicher hystricognather Nagetiere. Palaeovertebrata, *Mém. extra.*, 1–168.

MESERVE, P. L.; LE BOULENGÉ, E. (1987): Population dynamics and ecology of small mammals in the northern Chilean semiarid region. Fieldiana Zoology, N. S. **39**, 413–431.

MESERVE, P. L.; MURÚA, R.; LOPETEGUI, N. O.; RAU, J. R. (1982): Observations on the small mammal fauna of a primary temperate rain forest in southern Chile. J. Mammalogy **63**, 315–317.

MILLER, S. D.; ROTTMANN, J.; RAEDEKE, K. J.; TABER, R. D. (1983): Endangered mammals of Chile: status and conservation. Biol. Conserv. **25**, 335–352.

MONES, A. (1986): Palaeovertebrata sudamericana. Catálogo sistemático de los vertebrados fósiles de America del Sur, parte I. Lista preliminar y bibliografía. Courier Forschungsinst. Senckenberg **82**, 1–625.

MORGAN, G. S.; WOODS, C. A. (1986): Extinction and the zoogeography of West Indian land mammals. Zool. J. Linn. Soc. **28**, 167–203.

NIETHAMMER, J. (1964): Contribution à la connaissance des mammifères terrestres de l'île Indefatigable (= Santa Cruz), Galapagos. Mammalia **30**, 441–445.

NOWAK, R. M. (1991): Walker's mammals of the world. 5th ed. Baltimore: The Johns Hopkins University Press.

OSGOOD, W. H. (1943): The mammals of Chile. Field Mus. Nat. Hist., Zool. Ser. **30**, 1–268.

PASCUAL, R. (1967): Los roedores Octodontoidea (Caviomorpha) de la formación Arroyo Chasicó (Plioceno inferior) de la Provincia de Buenos Aires. Revista Mus. de la Plata (N.S., Paleontol.) **5**, 259–282.

PASCUAL, R.; PISANO, J. A.; ORTEGA, E. J. (1965): Un nuevo Octodontidae (Rodentia, Caviomorpha) de la formación Epecuén (Plioceno medio) de Hidalgo (Provincia de La Pampa). Ameghiniana **4**, 19–30.

PATTERSON, B. D.; FEIGL, C. E. (1987): Faunal representation in museum collections of mammals: Osgood's Mammals of Chile. Fieldiana, Zoology, N. S. **39**, 485–496.

PATTERSON, B. D.; GALLARDO, M. H.; FREAS, K. E. (1984): Systematics of mice of the subgenus *Akodon* (Rodentia: Cricetidae) in southern South America, with the description of a new species. Fieldiana, Zoology, N. S. **23**, 1–16.

PATTERSON, B.; PASCUAL, R. (1968): New echimyid rodents from the Oligocene of Patagonia, and a synopsis of the family. Breviora **301**, 1–14.

PATTERSON, B; WOOD, A. E. (1982): Rodents from the Deseadan Oligocene of Bolivia and the relationships of the Caviomorpha. Bull. Mus. Comp. Zool. **149**, 371–543.

PINE, R. H. (1973): Una nueva especie de *Akodon* (Mammalia: Rodentia: Muridae) de la isla de Wellington, Magallanes, Chile. Anales Inst. Patagonia **4**, 423–426.

PHILIPPI, R. A. (1900): Figuras i descripciones de los murideos de Chile. Anal. Mus. Nac. Chile, Ent. **14a**, Zool., 1–70.

REDFORD, K. H.; EISENBERG, J. F. (1992): Mammals of the Neotropics. Vol. 2. The southern cone: Chile, Argentina, Uruguay, Paraguay. Chicago: The University Chicago Press.

REIG, O. A. (1970): Ecological notes on the fossorial octodont rodent *Spalacopus cyaneus* (Molina). J. Mammalogy **51**, 592–601.

— (1986): Diversity patterns and differentiation of high Andean rodents. In: High altitude tropical biogeography. Ed. by F. VUILLEUMIER and M. MONASTERIO. New York: Oxford University Press. Pp. 404–439.

— (1987): An assessment of the systematics and evolution of the Akodontini, with the description of new fossil species of *Akodon* (Cricetidae: Sigmodontinae). Fieldiana Zoology, N. S. **39**, 347–399.

REIG, O. A.; QUINTANA, C. A. (1991): A new genus of fossil octodontine rodent from the Early Pleistocene of Argentina. J. Mammalogy **72**, 292–299.

REISE, D.; VENEGAS S., W. (1987): Catalogue of records, localities and biotopes from research work on small mammals in Chile and Argentina. Gayana, Zool. **51**, 103–130.

SANTIS, L. J. M. DE; ROIG, V. G.; JUSTO, E. R. (1991): La anatomia craneo-dentaria de *Tympanoctomys barrerae* (Lawrence). Comparacion con *Octomys mimax* y consideraciones acerca de su est[u]d[i]o taxonomico (Rodentia: Octodontidae). Neotropica (La Plata) **37**, 113–122.

SPOTORNO, A.; WALKER, L.; CONTRERAS, L,; PINCHEIRA, J.; FERNÁNDEZ-DONOSO, R. (1988): Chromosomas ancestrales en Octodontidae y Abrocomidae. Arch. Biol. Med. Exper. **21**, 527.

STEADMAN, D. W.; RAY, C. E. (1982): The relationships of *Megaoryzomys curioi*, an extinct cricetine rodent (Muroidea: Muridae) from the Galápagos Islands, Ecuador. Smiths. Contrib. Paleobiol. **51**, 1–23.

TAVERA, J.; VEYL, C. (1958): Reconocimiento geológico de la Isla Mocha. An. Fac. Cienc. Fis. Math., Univ. Chile **14–15**, 157–188.

THOMAS, O. (1920): On mammals from near Tinogastra, Catamarca, collected by Mr. R. W. Hendee near Lake Junín. Ann. Mag. nat. Hist. (9) **17**, 313–318.

VERZI, D. H.; MONTALVO, C. I.; VUCETICH, M. G. (1991): Nuevos restos de *Xenodontomys simpsoni* Kraglievich y la sistematica de los más antiguos Ctenomyinae (Rodentia, Octodontidae). Ameghiniana **28**, 325–331.

WATERHOUSE, G. R. (1844): On the various skins of Mammalia from Chile, with notes relating to them by Mr. Bridges. Proc. zool. Soc. London **12**, 153–157.

WALKER, E. P.; WARNICK, F.; HAMLET, S. E.; LANGE, K. I.; DAVIS, M. A.; UIBLE, H. E.; WRIGHT, P. F. (1964): Mammals of the world, vol. 2. Baltimore: The Johns Hopkins Press.

WEIR, B. J. (1974): Reproductive characteristics of hystricomorph rodents. In: The biology of hystricomorph rodents. Ed. by I. W. ROWLANDS and B. J. WEIR. Symp. Zool. Soc. London **34**. London: Academic Press. Pp. 265–301.

WOOD, A. E. (1949): A new Oligocene rodent genus from Patagonia. Amer. Mus. Novit. **1453**, 1–54.

— (1974): The evolution of the Old World and New World hystricomorphs. In: The biology of hystricomorph rodents. Ed. by I. W. ROWLANDS and B. J. WEIR. Symp. Zool. Soc. London **34**. London: Academic Press. Pp. 21–60.

WOOD, A. E.; PATTERSON, B. (1959): The rodents of the Deseadan Oligocene of Patagonia and the beginnings of South American rodent evolution. Bull. Mus. comp. Zool. **120**, 279–428.

WOOD, A. E.; WILSON, R. W. (1936): A suggested nomenclature for the cusps of the cheek-teeth of rodents. J. Paleont. **10**, 388–391.

WOODS, C. A. (1982): The history and classification of South American hystricognath rodents: reflections on the far away and long ago. Special Publ. Ser. Pymatuning Lab. Ecol., Univ. Pittsburgh **6**, 377–492.

WOODS, C. A.; BORAKER, D. K. (1975): *Octodon degus*. Mammalian Species **67**, 1–5.

WOODS, C. A., HOWLAND, E. B. (1979): Adaptive radiation of capromyid rodents: anatomy of the masticatory apparatus. J. Mammalogy **60**, 95–116.

Author's address: Dr. RAINER HUTTERER, Zoologisches Forschungsinstitut und Museum Alexander Koenig, Adenauerallee 162, D-53113 Bonn 1, Germany